Stoichiometry of Thermochemical Equations
Honors Chemistry Problems
from Silberberg

1. Is ΔH positive or negative when one mole of water vapor condenses to liquid water?

2. Consider the following balanced thermochemical equation for a reaction sometimes used for H_2S production.

$$\frac{1}{8}S_8 + H_2 \rightarrow H_2S \quad \Delta H = -20.2 \text{ kJ}$$

$2.60 \text{ mol } S_8 \times \frac{-20.2 \text{ kJ}}{1/8 \text{ mol}}$

a.) Is this an exothermic or endothermic reaction?
b.) What is the ΔH for the reverse reaction? 20.2 kJ
c.) What is ΔH when 2.60 moles of S_8 react? = −420.16 kJ
d.) What is ΔH when 25.0 g of S_8 react?

$25 g\, S_8 \times \frac{1 \text{ mol } S_8}{256.5 g} = 0.097 \text{ mol} \times \frac{-20.2}{1/8 \text{ mol}} = -15.7 \text{ kJ}$

3. When 1.0 mole of NO forms from its elements, 90.29 kJ of heat is absorbed.

a.) Write a balanced thermochemical equation for this reaction.

$\frac{1}{2} N_2 + \frac{1}{2} O_2 \rightarrow NO \quad \Delta H = 90.29 \text{ kJ}$

b.) How much heat is involved when 3.50 g of NO decomposes to its elements?

$3.50 g\, NO \times \frac{1 \text{ mole}}{30.01} = 0.117 \text{ mol } NO \times \frac{-90.29}{1 \text{ mol}} = -10.6 \text{ kJ}$

4. Liquid hydrogen peroxide releases oxygen gas in its decomposition.

$$2\, H_2O_2 \rightarrow 2\, H_2O + O_2 \quad \Delta H = -196.1 \text{ kJ}$$

How much heat is released when 652 kg of H_2O_2 decomposes in a rocket fuel mixture?

$652{,}000 g \times \frac{1 \text{ mole}}{34.02 g} = 19165.2 \text{ mol} \times \frac{-196.1 \text{ kJ}}{2 \text{ mol}} = -1{,}879{,}147.9 \text{ kJ}$

5. Consider the reaction: $MgCO_3 \rightarrow MgO + CO_2 \quad \Delta H = 117.3 \text{ kJ}$

a.) Is heat absorbed or released in the reaction?
b.) What is the ΔH for the reverse reaction? −117.3 kJ
c.) What is ΔH when 5.35 moles of CO_2 reacts with excess MgO? $5.35 \text{ mol} \times \frac{-117.3}{1 \text{ mol}} = -627.6 \text{ kJ}$

d.) What is ΔH when 35.5 g of CO_2 reacts with excess MgO?

$35.5 g\, CO_2 \times \frac{1 \text{ mol}}{44.01 g} \times \frac{-117.3 \text{ kJ}}{1 \text{ mol } CO_2} = -94.62 \text{ kJ}$